Emotional Support Domestic Robots for Healthy Older Adults: Conversational Prototypes to Help With Loneliness

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ABSTRACT

A burgeoning area of HRI explores how robots can be used to assist older adults who are dealing with health issues. However, much of this work focuses on aiding older adults that are living with dementia or other serious health-related problems. In this work, we focus on robots helping otherwise-healthy older adults living with social isolation and loneliness. We created an initial robot behavior design, which leverages techniques from therapy, to provide emotional support through basic conversational ability.

KEYWORDS

Domestic Robots, Emotional Support, Older Adults, Social Robots

ACM Reference format:

Annalena Nora Baecker, Denise Y. Geiskkovitch, Adriana Lorena González and James E. Young. 2020. Emotional Support Domestic Robots for Healthy Older Adults: Conversational Prototypes to Help With Loneliness. In *Companion Proceedings of 2020 ACM International Conference on Human Robot Interaction (HRI'20), March 23–26, 2020, Cambridge, United Kingdom.* ACM, 2 pages. https://doi.org/10.1145/3371382.3378279

1. Introduction

As the older adult population continues to increase around the world [16], research is focusing on exploring different ways in which robots can help with age-related challenges. Since older adults are at a higher risk of physical impairments, dementia, and serious mental health problems [7], human-robot interaction work has focused heavily on these challenges (e.g., [6, 11, 17]). For example, animal-like robots, such as PARO [17] and AIBO [15], have the potential to reduce behavioral and psychological symptoms, increase motivation for exercise [8], and improve the quality of life for people living with dementia [9, 17].

In addition, otherwise-healthy older adults are increasingly facing mental health concerns stemming from social isolation and loneliness, such as depression, stress, and anxiety [7]. While social robots can be designed to impact a person's feelings, mood, and behaviors [1, 17], there is as of yet limited work in this area for older adults [3, 4, 10].

In this paper, we present an initial social robot design specifically targeted to provide emotional support for healthy older adults who may be experiencing minor mental health problems. We build upon prior work by designing a conversational robot (in contrast to a pet-like robot to be held or cared for), which provides expanded support possibilities not possible with simpler robots.

HRI '20 Companion, March 23–26, 2020, Cambridge, United Kingdom

ACM ISBN 978-1-4503-7057-8/20/03.
https://doi.org/10.1145/3371382.3378279

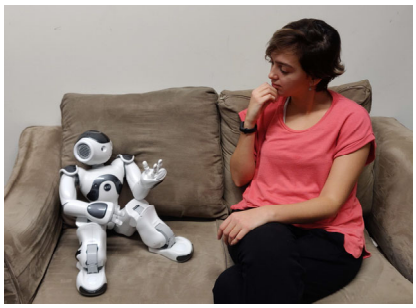

Figure 1. A person sits at home with an emotional support robot and has a conversation about their day.

A keystone of our robot design is to aim for robust robot behaviors immediately deployable into domestic environments long term, instead of employing common narrow in-lab short-term Wizard of Oz studies. Thus, from the beginning we aim to provide benefits of social robots (empathy and rapport building [13, 14], social signals [5]) with minimal behavior complexity and the robot having little or no social awareness or contextual understanding. That is, our goal is to create autonomous robot behaviors that are technically simple and robust, thus feasible to deploy, and yet leverage the benefits of social interaction. We argue that this is a key design challenge that must be solved for successful domestic robots.

2. Novel Emotional Support Robot Design for Healthy Older Adults

Techniques such as reflective listening, where a therapist rephrases what a person says, are common in psychotherapy to help people living with anxiety and depression [12]. For example, an individual might say to their therapist, "I am so mad that John passed away" to which the therapist might reply, "So what I hear is that you are angry that John is no longer with you, is that correct?", and so on. While this enables the therapist to confirm their understanding, more importantly, this approach allows the person to hear their ideas reflected back at them, supporting introspection and consideration of how they talk about their problems and issues. We suggest that a social robot could feasibly implement a range of rudimentary reflective listening behaviors by listening to a person's speech and reflecting variants of their words back to them.

2.1 The Repeat-Back Domestic Robot Design

We suggest a robot can use simple verbal interaction techniques for discussion. The robot can listen, provide acknowledgment, and respond by either repeating what the person said (e.g., verbatim,

recorded, paraphrased, etc.) or with simple pre-programmed (but varying) phrases relating to what the person mentioned. This can provide a robotic analogue to reflective listening therapy.

We envision that this behavior could be embedded within a small domestic robot (e.g., humanoid), which sits on a chair or small table, and is available for discussion whenever desired. This domestic emotional-support robot could leverage physical social rapport-building techniques (in comparison to less effective virtual techniques [14]), such as maintaining eye contact and an open posture [13], to build and support an emotional connection with a person. A person can either prompt the robot to start a therapy session, or can be prompted by the robot (e.g., daily), to share their current thoughts and feelings, while the robot listens and responds accordingly. The robot would not provide advice, given the complexity of doing it appropriately. In short, the robot provides emotional support through active listening, directly in a person's comfortable and intimate home environment, using a friendly and approachable physical embodiment and non-judgmental responses intended to have individuals reflect on their problems.

2.2 Design Considerations

Due to the sensitive nature of this design space, both in terms of the in-home environment and potentially private topics of conversation, the person's privacy and control over all data collected is of utmost importance. As such, for our current prototype our robot does not use any cloud services or have any internet connectivity, with all processing being done offline and on-machine. If our prototype requires further computational resources, we intend to place a server that the robot can communicate with (not connected to the internet) within the same house. Further, we enable people to press a prominent button on the robot (on its chest) to immediately erase all data collected.

We pay careful attention to the problem of expectation discrepancy, where people may expect much more functionality from the robot than what it is actually capable of [2]. To mitigate this, a key component of introducing the robot into homes is to explain the actual minimal, very low capability it has.

2.3 Interaction Design

To begin a self-reflection discussion session, the older adult would touch one of the robot's sensors to initiate interaction; this is to avoid the robot mis-interpreting unrelated conversation as intention to begin interaction. In addition, a robot could perhaps prompt a person if they did not have an interaction for several days, for example, by raising its hand indicating it wants to talk if it detects a presence in the room (e.g., movement or sound). Below we propose three different behavior prototypes.

2.3.1 Audio Diary

This pattern would have the robot record what a person says, and read it back to them (in the robot's voice or their own) while making gestures and eye contact. For example:

<person touches robot's head>
Robot: Let's have a voice diary session. I will record everything you say until you tell me that you are done. Please indicate that you are done by saying "I'm done now, thanks." Say "yes" if you would like to start.
Person: Yes.
Robot: OK, I am now recording. Please start.
Person: I've been upset all day. This morning, at the grocery store… …and that's why it makes me upset. I'm done now, thanks.
Robot: Thank you. I will now read back what you said. You can stop me at any time by touching my head, or saying "Stop please". … <starts> … <ends> thank you. Would you like me to read it again, or erase my records?
Person: Erase please.
Robot: The record has been erased. Thank you for chatting with me.

2.3.2 Probing Listener

This pattern would have the robot perform rudimentary text analysis (e.g., akin to the classic Eliza chat bot), to enable it to form questions from statements the person made. This will be implemented using keyword recognition in the person's speech. Unlike the audio diary pattern, here the robot aims for a more engaged dialog. An example conversation might be as follows:

<person touches robot's head>
Person: Hi, I would like to talk.
Robot: What would you like to talk about?
Person: I miss spending time with family. Ever since my kids moved away, I don't get to see them or my grandchildren very often.
Robot: It sounds like you miss your family and wish to spend more time with them.
Person: Yes, I really do miss them. Maybe I should call them.
Robot: That sounds good.
<conversation continues>

2.3.3 Daily Check-In

Here, the robot would attempt to engage the person once a day to ask general questions about how their day went. If a person does not engage the robot for a day, it would raise its hand and look at any detected person to indicate that it wants to have a discussion. Once the person initiates the conversation, the robot then asks a series of generic questions to encourage the person to reflect on their day. This includes questions such as "what did you do today?", "how are you feeling today?", "did you see any friends today?", "did you manage to get out today?", etc.

2.4 Next Steps

These simple behavior patterns are designed to minimize the complexity of the robots and for immediate feasibility. However, this is just a first step toward creating emotional support robots, where ultimately the robots will be more complex; the current simplicity is for initial deployment. If successful, we envision that these simple robots will serve as a starting point from which we can design and test more complex behavior, for example, which relies on social cognition (detecting user emotion, situation), long-term learning (predicting person's reactions, tailored feedback), or advanced physical capability (navigation, following people).

Conclusion

In addition to supporting older adults with serious health concerns or cognitive impairments such as dementia, we note the importance of developing supportive domestic social robots for healthy older adults who may be living with anxiety and depression due to loneliness. We present a novel approach to emotional support robots, and three original prototype designs, that are feasible and deployable into homes, and yet leverage the known benefits of social robots. We envision that this will serve as a starting point for increased success and development of achievable domestic robots.

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